DOCUMENT RESUME

ED 150 546 CS 003 910

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TITLE Interrelationship of Orthography and Phonological Structure in Learning to Read. Technical Report No. 57.
INSTITUTION Bolt, Beranek and Newman, Inc., Cambridge, Mass.; Illinois Univ., Urbana. Center for the Study of Reading.
SPONS AGENCY National Inst. of Education (DHEW), Washington, D.C.
PUB DATE Jan 78
CONTRACT 400-76-0116
GRANT NIE-G-74-0007
NOTE 62p.

EDRS PRICE MF-$0.83 HC-$3.50 Plus Postage.
DESCRIPTORS *Beginning Reading; Bilingualism; Cross Cultural Studies; Diachronic Linguistics; *Literature Reviews; *Orthographic Symbols; *Phoneme Grapheme Correspondence; *Phonology; *Reading Research
IDENTIFIERS *Center for the Study of Reading (Illinois)

ABSTRACT

Literature related to orthography, phonology, and reading is reviewed and synthesized in order to develop a rationale for a "goodness of fit" hypothesis. This hypothesis asserts that a writing system which is more consistently fit to the phonological structure of a particular language is more likely to facilitate learning to read. Conversely, a language whose writing system is less consistent or more abstract is likely to lead to more difficulty for the child learning to read. This claim is examined in the context of studies on various writing systems, cross-cultural and bilingual research, history of the language, and studies on English generative phonology. (Author/AA)

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CENTER FOR THE STUDY OF READING

Technical Report No. 57

INTERRELATIONSHIP OF ORTHOGRAPHY AND PHONOLOGICAL STRUCTURE IN LEARNING TO READ[1]

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January 1978

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The research reported herein was supported in part by the National Institute of Education under Contract No. US-NIE-C-400-76-0116 and Grant No. HEW-NIE-G-74-0007.

The National Institute of Education
U.S. Department of Health, Education and Welfare
Washington, D.C. 20208

CS003910

Interrelationship Of Orthography And Phonological Structure in Learning To Read [1]

Introduction

Educators for centuries have singled out the spelling system of English as one of the major barriers to teaching children to read. The assumption underlying this claim is that the correspondence or "goodness of fit" between English orthography and speech is so irregular and inconsistent that the child has difficulty in making the connection between the printed word and its oral counterpart, which is the only meaningful form of language the child knows upon entering school. This lack of direct correspondence is generally assumed to discourage children's persistence in the earliest stages of reading instruction, often to the point where they ultimately abandon their attempts at learning to read. Educators and lexicographers have repeatedly attempted to attack what they viewed as a major problem either by instituting prescriptivism or spelling reform movements (Hart, 1570; Johnson, 1755; Webster, 1789; Pitman, 1905); or by proposing transitional pedagogical alphabets (Downing, 1965; Gleitman & Rozin, 1973; Rozin & Gleitman, in press) which have been used for attaining initial literacy before switching to the accepted English orthography.

The claim that "irregularities" in spelling discourage reading implies that a more "regular" writing system, that is, one in which the fit between symbol and sound is more direct, will be more efficient for learning to read. As the child encounters his initial reading tasks, he must first recognize that the writing system corresponds to his spoken language. Hence, the correspondence or "goodness of fit" between a writing system and the phonological

structure of the child's language is one of the crucial factors in learning to read. If the "goodness of fit" is close, the associations which the child makes between oral and written language will be facilitated. Conversely, the poorer degree of fit, the more difficult and frustrating will be his encounters in learning to read. This hypothesis follows from Downing (1973, p. 239) who states: "The greater the mismatch--or the wider the gap between the child's linguistic experiences and the literacy task to be undertaken--the more difficult it will be for the child to learn these skills."

In this report, the nature and validity of the "goodness of fit" hypothesis will be examined in the light of research findings in comparative education, English historical linguistics, lexicography, psycholinguistics, and especially applied linguistics in bilingual and reading education. This report is divided into several sections. In order to discuss the relevance of the "goodness of fit" hypothesis to understanding beginning reading, it is necessary to examine various existent writing systems for different languages. In order to provide support for the effect of the relationship on learning to read in languages other than English, bilingual programs will be discussed. An historical perspective on English orthography and spelling reform will illustrate the development of a poorer "goodness of fit" for English. Finally, claims about English orthography and learning to read made by some generative linguists will be evaluated.

It will be assumed that reading is an interactive process whereby the child learns to use clues from his knowledge of the world and from his awareness of syntax, phonology, and orthography in order to construct a meaning

for what he is reading. However, it is necessary to make a clear distinction between what a child must master in order to become literate, and what a literate adult does when he reads. A child learning to read needs more awareness of the nature of the writing system and its relationship to phonological structure than does a fluent adult reader (Gillooly, 1973). Although decoding is not the essence of reading (Goodman, 1967), the development of "word attack skills" forms an introductory component of almost every method for teaching reading. The ease of learning the relationship between orthography and phonological structure depends on the nature of the writing system and language involved.[2]

Writing Systems and Learning to Read

Two main types of writing systems can be identified: Those whose symbols correspond to whole morphemes or words of the language are logographic systems. Those whose symbols correspond to the phonological structure of the language are syllabaries and alphabets. The symbols in a syllabary correspond to syllables while the symbols of an alphabet correspond to individual sounds. It is with syllabaries and alphabets that the concept of the "goodness of fit" takes on most relevance for learning to read.

Logographic systems. Logographic systems by definition require associations between symbols and meanings, rather than symbols and sounds. Thus, there is hardly any degree of goodness of fit. Thus, learning to read the logographic system of Chinese is a monumental task. The Chinese logographic system contains several subsystems (Leong, 1973, p. 385-386): pictographs derived from pictures of the object; ideographs, representing ideas as 'up', 'down';

compound ideographs based on metaphorical extensions or associations of constituent parts (e.g., the graph for 'bright' is derived from the combination of the logograph for 'sun' and 'moon'); loan characters derived from the other characters with similar sounds; chuanchu characters, patterned by analogy to older symbols with similar meaning; phonetic compounds consisting of two components: a significant which provides the meaning of the symbol, and a phonetic which provides clues to pronunciation.

The reader develops the ability to predict some meaning through an "analysis by synthesis" based on the combination between the "phonetic" and the "significant" elements of written words (Wang, 1973). For example, the phonetic character for /pāw/ 'package' may be combined with a variety of significs or radicals as shown in Figure 1.

Insert Figure 1 About Here

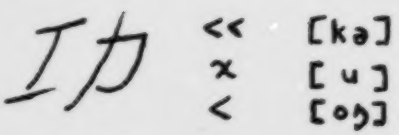
The significant for 'hand' when combined with the phonetic yields the character for 'carry'. Similarly, the significant for 'fire' when combined with the phonetic yields the character meaning 'firecracker'. Likewise, the significant for 'water' combined with the phonetic yields 'bubble'. All three logographs are pronounced like the phonetic form 'carry'/pàw/. Thus, as Wang (1973, p. 51) points out, the proficient reader of Chinese who encounters a new character 铹 will analyze its pronounciation as [lóng]. 龙 and guess that it is some type of metalic compound because the significant 钅 means "gold". Chinese writing also gives clues to meaning through reduplication: 木 'tree', 木木 'woods', 森 'forest'. Learning to read the Chinese

characters does not always involve rote memory learning because the combinatory properties of symbols may also assist the recognition of the meaning. Nevertheless, learning to read Chinese is a complicated task which is currently aided by the use of another writing system which has been designed to have a close "goodness of fit" to the spoken standard dialect.

For centuries literacy in China was confined to the bureaucracy and reading was taught primarily through writing. Yet in the 20th century the literacy scene has changed (Lehmann, 1975). As part of the National Romanization movement, Chao and his colleagues devised an alphabetic writing system (Gwoyea Romatzyh - G. R.). The alphabet was originally planned for use in communicating with foreigners who would naturally have difficulty in reading the logographic system, and it was also used as an auditory mnemonic device to assist in the learning of characters in Chinese primary schools. In the late 1950s, as part of a general language reform movement, an alphabetic system employing Latin symbols, referred to as pinyin, was introduced in mainland China. Today, pinyin is used to promote the standard dialect and to facilitate initial learning of reading.

Children are first introduced to pinyin as a transitional alphabet for learning literacy of the Chinese logographic system. Children first learn the names of the consonants and study vowels, nasal finals, and diphthongs. Children later learn to analyze syllables into phonemic segments. By the time children enter second grade they are given reading lessons aiding transition from pinyin to the logographs. Typically, the teacher introduces a new Chinese character with its pinyin counterpart.

For example, the character for 'merit' /kōɲ/ will be written on the blackboard as follows:



The teacher then discusses the component parts of the Chinese character in terms of the radical (signific) and the pronuciation:

工 [kōɲ] means 'work', and

力 [li] means 'strength'

Thus, the children learn the pronunciation, meaning, and method of writing for each Chinese character. By the end of primary school, children learn 2800-3000 logographs through the use of pinyin (Lehmann, 1975, p. 56). Thus, it appears that the Chinese have chosen to circumvent the problem involved in teaching literacy via a writing system which would tax the memory capacity of young children. This has been done by providing the children with an alphabetic writing system which has a high degree of "goodness of fit" for the initial reading experience.

The two types of writing systems that map onto the phonological structures of language are referred to as syllabaries and alphabets. In a syllabary the symbols may correspond to many combinations as consonant-vowel (CV), vowel-consonant (VC), or consonant-vowel-consonant (CVC). The symbols of an alphabet correspond, in principle, to the individual sound segments of the language.

Syllabaries. With the exception of Cherokee, Japanese is the only modern language with a true syllabary. More precisely, the Japanese system

is a combination of scripts: two syllabaries (Hiragana and Katakana), and a logographic system (Kanji). Hiragana is used primarily for affixes and native words. Katakana is commonly used for borrowed words and foreign proper names. Kanji, which is adapted from Chinese characters, is most commonly used for roots. The combination of the syllabic Kana scripts with Kanji allows the root word to be readily identified. The Kanji symbol has a direct mapping onto the meaning, although it may have two or more pronunciations, depending on how the Kanji is combined with the Kana element or other Kanjis. The syllabic components of Japanese script are far more regular in that there is almost a direct mapping, a high degree of "goodness of fit", between the sign and the syllabic unit of sound. This is due to the fact that the Japanese phonological system is composed of a limited number of syllabic types, primarily CV, which can be combined to form polysyllabic words. Japanese children are first introduced to the Hiragana syllabic script used entirely in beginning texts. Children are then introduced to the Katakana syllabic script. However, Japanese Kanji, the logographic subsystem, causes children some difficulty. Through the grades the children gradually learn to use the Kanji characters for the root words, instead of the originally learned syllabic symbols (Sakamoto & Makita, 1973).

Rozin and Gleitman (In press) claim that the syllable is more accessible and stable than phonemes and therefore the syllable provides better cues to initial reading.[3] Makita (1968) and Sakamoto and Makita (1973) argue that the acquisition of decoding skill in Japanese is facilitated because of the high degree of fit between the syllabaries and the phonological structure of Japanese. Thus, the possibility of the accessibility

of the syllable as a basic unit of speech perception and production, and the reality of "goodness of fit" allow for the relative ease of acquiring word recognition skills in Japanese.

Alphabets. The most common type of writing system is the alphabet. The symbol of an alphabet differs from the symbol of a syllabary in that the former corresponds in principle to smaller units of phonological structure: phonemes or phones. Yet the manner and degree of the mapping may vary from script to script and from language to language. Gelb (1952) and Gray (1956) classify alphabetic languages into three categories on the basis of how vowels are represented: those where the vowels are indicated by separate symbols as in the Greek, Roman, and Cyrillic alphabets; those where the vowel sounds are indicated by diacritical markings as sometimes in Hebrew and Arabic; those where the vowels are indicated by modifying a consonant symbol or by attaching other markers to the consonant symbol as in Hindi. In some languages, the graphic shapes of alphabetic symbols may vary depending on their position in the word. For example, a particular consonant sound in Arabic and Persian may have different graphic shapes depending on whether the sound is word initial, final, or medial. Vowel sounds are often not indicated in the Arabic/Persian script except in the Koran, in beginning reading texts, and in texts for foreigners. If the vowel letters are omitted, the reader must therefore depend more on context and surrounding consonants for clues to word recognition and meaning.

In the Indic scripts (Devanagari, in particular), vowel sounds are indicated by "matra" signs attached above or below the consonant. However,

if the vowel is syllable initial, a full vowel symbol is usually used. For example, the verb 'to come' [ana] is spelled आना, the initial phoneme /a/ is spelled with a full vowel symbol आ ; but, the final vowel phoneme /a/ is spelled with a matra 'ा' attached to the preceding consonant न. Other features of the Devanagari system include the simplification of the first consonant in consonant clusters: न् + द ⇒ न्द as in जल्दी [jaldi] 'soon': and the use of a headline across the top of letters to indicate the length of the word.

The Roman alphabet is the most widely used writing system; but its correspondence to speech will depend on the particular language. An alphabet may also be mapped onto various levels of phonological structure of the particular language. There can be a correspondence of spelling to surface phonetic representation; or, to more abstract underlying levels of language.

Phonetic spellings by definition represent many acoustic characteristics of a particular segment of speech. If English orthography were primarily phonetic, it would reflect phonetic alternations of the same phoneme. For example, English voiceless stop consonants are aspirated word initially before vowels. Thus, the /t/ phoneme in tap is aspirated [$t^h æ p$]; but the /t/ in stop is not aspirated [stap]. English orthography doesn't generally reflect minute phonetic levels of words, except in cases where variants are frozen in the spelling historically. The p in words like Thompson (son of Tom), Sampson (son of Sam) reflects the occurrance of a phonetic [p] which occurs as a result of a common articulatory process of epenthesis whereby

a stop consonant commonly occurs between nasals and fricatives or liquids. Thus, there are cases where English spelling represents surface phonetic forms.

An alphabet may also reflect more abstract levels of phonological structure. In English, spellings which are sensitive to an underlying level represent the underlying phonemic contrasts of words which on the surface have similar pronunciations. Consider the spelling contrasts between /t/ and /d/ as represented in the spellings writer and rider. The medial consonant grapheme preserves the underlying contrast between the phonemes /t/ and /d/ just as in the pairs write and ride. However, the pronunciation of the /t/ and /d/ in writer and rider are similar and almost indistinguishable in many dialects of standard American English. Although a phonetic contrast may be made by the vowel length preceding the voiced consonant; the spelling reflects a phonemic contrast in the consonant.

Another case of an abstract mapping between orthography and speech is to be found very frequently in German, and partially in English. These languages have many spellings corresponding to morphophonemic structure of words. Consider the paradigm for German in Table 1, adapted from Moulton (1966, p. 129). Within the paradigm for 'advice', the phonemic patterns of

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Insert Table 1 About Here

/t/ remains constant: /rat + case marking/. The constant form is reflected in the spelling for 'advice': rat, rate, etc. Compare the paradigm for 'advice' to the paradigm for 'wheel'. Here the root morpheme undergoes a

morphophonemic alternation between /t/ and /d/: /ʀ̊aɪ̯t/ ∿ /ʀ̊aɪ̯dəs/. However, the spelling reflects only one form throughout the paradigm: rad, radə, rad, etc. The alternation of /d/ and /t/ is predictable in German where the stem final voiced consonant /d/ alternates with /t/ word finally and before /s/. The /d/ is preserved invariantly in the spelling, but pronounced as [t] in the predictable places. Another advantage of the morphophonemic spelling for 'wheel' is that there is a distinct contrast of the 'wheel' spelling paradigm with the 'advice' spelling paradigm. Morphophonemic spellings therefore preserve morphemic identity within a paradigm, although the pronunciation of certain phonemes are predictable by the system of language. English orthography, although primarily a phonemic writing system, is often morphophonemic. The roots in words like nation ∿ national; cave ∿ cavity; telescope ∿ telescopy; crime ∿ criminal; resident ∿ residential are pronounced differently. Although the root vowels are pronounced with two separate sounds, the spelling preserves the meaningful relationship of the words in the paradigm.

Thus far it was shown that the "goodness of fit" hypothesis involves the orthography being mapped onto various levels of phonological structure. Furthermore, phonemic writing systems may have various degrees of "goodness of fit" depending on the particular language. Three types of correspondences have been identified by Chao (1968, p. 111): one symbol to one sound as most completely in Finnish (e.g., te [te] 'you', tee [te·] 'tea', tuli [tuli] 'fire', tuuli [tu·li] 'wind', maksa [maksa] 'liver', maksaa [maksa·] 'costs'); many spellings to one pronunciation as in French (e.g., ancien, certain, moyen,

plein, devin / ɛ̃ /); and many symbols to many sounds as in English (e.g., way, weigh, wait, fate /e/; o one [wʌn], do [du], open [opən], oven [ʌvən], women [ɪ]. Because of the different types of alphabetic writing systems and the various types of correspondences between symbols and phonological units, it seems appropriate at this point to ask the question: To what degree does the "goodness of fit" between orthography and speech determine the child's success in learning to read? The evidence that is needed to answer this question are learning studies in languages whose orthographies differ in the "goodness of fit." Much available evidence is found in cross-cultural and bilingual education studies.

Cross-Cultural and Bilingual Studies on Learning to Read

From available studies on learning to read in languages with different types of orthographies, one can see that the relationship between orthography and phonological structure is an important variable in determining the difficulty of learning to read. The studies of Makita (1968) and Sakamoto and Makita (1973) suggest that the regular syllabic system of Japanese is relatively easy to acquire by grade 3. A survey of Japanese schools by Makita (1968) indicated that children with reading disabilities comprise only 0.98% of the Japanese population, about one-tenth the percentage found in countries which use the Latin alphabet. Makita (1968) concluded that the orthography and its relationship to speech "Is the most potent contributing factor in the formation of reading disability (Makita, 1968, p. 613)." Some of the linguistic arguments he raises in support of this contention are:

1. Unlike the English alphabet, which has some mirror image consonants (p, q, d, b), Japanese Kana has no mirror image pairs.
2. Depending on the combination of certain English letters with others, ambiguities of pronunciation often occur. For example, the combination of t and h or s and h may be ambiguous: hothead vs. heather, mishap vs. bishop. In Japanese, consonants cannot be combined because there is usually vowels associated with them.
3. Whereas English orthography has a "many-to-many" symbol to sound fit, Japanese has a very consistent one-to-one fit between the syllabic symbols and the spoken syllables.

Thus, a high degree of "goodness of fit" is established for initial learning to decode in Japanese. However, as Kanji, the logographic component of Japanese orthography, is introduced, reading difficulties are more frequent. Japanese would appear to be a classic example of the "goodness of fit" playing a role in children's initial learning to read. However, more striking evidence is found in studies where bilingual children learn to read in the second language and transfer initial reading language skills to the mother tongue.

The French-English bilingual research in Canada suggests that native English children, when first taught literacy in their second language, are able to transfer some reading skills to the mother tongue. The St. Lambert Immersion program (Lambert & Tucker, 1972) is a prime example. Native English speaking children were placed in a French curriculum in kindergarten. English language arts instruction wasn't introduced until grade 2, when the

children spent two 1/2-hour periods per day learning English. By grade 5, both English and French language arts instruction were given relatively equal status. At the end of each year, the performances of native English speaking children in the immersion program were compared to those of a control group who learned to read in English. At the end of the first year there was a great transfer of cognates. At the end of later years, children performed as well in English as the monolingual control group. However, the French reading skills lagged behind those of the monolingual control groups of French. In general, the result was that although the immersion children's general language skills in French lagged behind their skills in English, some literacy skills did transfer to English. The transfer can be explained in terms of similarities in syntax allowing the development of common perceptual strategies (Bever, 1970; Cowan, 1976) and also by the similar spellings of cognates across alphabetic systems (e.g., accompagner - accompany, amuser - amuse, armée - army, famille - family). An additional factor may be the reinforcement at home of the mother language (c.f. Cowan and Sarmad 1976).

Another total immersion project was undertaken in Ottowa reported by Barik and Swain (1975). Although the English speaking children who learned reading in French in grade 1 were slightly behind the English control group in learning to read in English, the immersion children were beginning to transfer reading skills to English. This transfer was suggested by their scoring at the 40th percentile in reading. By the end of grade 2, the immersion children's ability in English language arts skills were comparable to the control group.

Barik and Swain (1974) hypothesize that French immersion programs may be comparable or better than half-time bilingual programs because the

children learn initial reading in only one language, rather than two simultaneously; and because native English speaking children learning to read in French may take advantage of the more consistent correspondences between the sounds and symbols which French provides. Barik and Swain (1975, p. 16) suggest that initial literacy doesn't necessarily have to be introduced in the mother language. McDougall and Bruck (1976) concluded from immersion programs in Quebec that delaying English reading instruction until grade 3 wasn't harmful to native language skills as a result of promoting literacy in the second language, French.

The French-English bilingual studies have challenged the assumption that, for bilinguals, literacy is best taught in the mother tongue. One of the major factors in examining this general practice is the "goodness of fit" between the orthography and phonemes of the particular languages involved. Could it be that initial literacy should be successfully introduced in the language in which the "goodness of fit" is more consistent? In the case of French and English, the Canadian bilingual programs suggest that children can learn reading in a second language and learn to transfer some literacy skills back to English, the mother tongue. To summarize, the Canadian research indicates that there are three linguistic factors which facilitate a partial transfer of reading skills from French to English: (a) the partial similarities of syntactic structure and vocabulary allow for the development of common syntactic processing strategies and common recognition of cognate vocabulary; (b) the alphabetic orthographies preserve the vocabulary similarities in both languages; (c) the children learn to read the more simple spelling-to-sound code first (French, the second

language) and later learn to tackle the more complex reading code in the mother tounge, English.

The role of the above linguistic factors, as well as the child's cultural background, are shown to be important in learning to decode as the French-English studies are contrasted with the Persian-English bilingual studies (Cowan & Sarmad, 1976). Persian and English share few similarities in linguistic structure, and none in their writing systems. Cowan and Sarmad (1976) summarize some of these differences which may affect reading as follows: Persian is a language where the agent and object morphemes are bound to the verb stem. Thus, the order of perception for Persian speakers is verb-agent-goal. But for English speakers, the order of perception is different: subject-verb-object. Persian attributive adjectives follow their nouns; the opposite is true in English, generally. Some of the important differences in alphabets are: English is written from left to right; Persian (Arabic script) is written from right to left. English has invariant letter shapes; while the shapes of Persian letters often depend on their position in a word. English letters are more distinctive in shape; while Persian letters are less distinguishable from each other. Finally, all English vowels are represented either by single symbols or digraphs; while in Persian, only three vowels are represented. These factors play a role in learning to read in bilingual programs.

In a cross-sectional Persian-English bilingual study, Cowan and Sarmad (1976) compared performances of children in grades 1, 3, and 6, according to the type of school and home language. In general, the result was that

the children in bilingual programs did not learn to read just as well as monolinguals in either language. Cowan and Sarmad hypothesized that because of the dissimilarities between the two linguistic systems, the Persian-English bilingual child develops two parallel sets of syntactic reading strategies for the two languages, while the French-English bilingual child has an advantage of relying on more similar syntactic structures between the two languages, and relying on the transfer of some vocabulary preserved in their common spellings. In the Cowan and Sarmad study, the reinforcement of the home linguistic environment seemed to have the greatest overall effect on reading performance. Hence, if the child came from a home where Persian was spoken by the parents, then his performance in Persian reading in a bilingual educational setting was usually stronger than his performance in English reading.

The above discussion of bilingual and cross-cultural learning studies suggests that (1) it is possible to learn initial literacy in a particular second language where the "goodness of fit" is more direct, provided that (2) there are similarities between the particular languages along the dimensions of orthography, vocabulary, and syntax, all of which play an important role in facilitating or impeding transfer of initial reading skills.

English Orthography, Historical Change, and Spelling Reform

A major controversy over centuries is whether English orthography should be reformed to establish a high degree of "goodness of fit" between spelling and phonemic structure of words. Many questions regarding this controversy can be discussed in an historical perspective. How did the

"goodness of fit" between English orthography and speech become more complex and "irregular?" What were some of the many attempts at promoting a more consistent "goodness of fit" in English? Why have many attempts failed? In the course of discussing these questions in this section, it will be shown that the "goodness of fit" in English is not very consistent because of natural historical linguistic change and because of many of the spelling reform movements.

Toward spelling irregularity. Four factors have contributed to the long recognized irregular aspects of English spelling: synchronic phonetic articulatory processes and diachronic change; the borrowing of foreign spelling conventions and foreign words; etymological respellings and spelling change through analogy; and spelling pronunciations. Each of these affected parts of the written language, thus enriching modern spelling with vestiges of linguistic and cultural history at the expense of losing a close "goodness of fit" between symbols and phonemes.[4]

Before English spelling became stabilized after the invention of the printing press and the development of dictionaries, a written form of a word was at the mercy of the particular scribes. There were many cases where scribes recorded a phonetic form rather than a phonemic form of a word. The spelling would reflect common articulatory processes. A common phonetic process is epenthesis, the occurrence of a homorganic stop consonant in transition from a nasal consonant to a fricative or liquid. Such was the case with crumble where the b sound evolved phonetically between /m/ and /l/; but the b grapheme is retained today as a silent consonant in the morpheme crumb.

Similarly, the p grapheme in words like Thompson or Sampson reflects the same phonetic process. Although it is natural for pronunciations to change, spellings rarely have changed to the newer pronunciation. There are many examples where English has undergone sound changes, but leaving fossils in the unchanged spelling. The loss of /k/ before /n/ results in the silent initial consonant in knife and knight. The Old English /x/, now reflected in the spelling gh, is preserved in words like right, brought. The Great Vowel Shift, which occurred between the Middle English and the Early Modern English period, effected a reorganization of the English vowel phonemes without a corresponding shift in the spelling of the vowels. In general, all the long vowels came to be pronounced with a higher position of the tongue, thus raising the vowel sound. The vowels that were not able to be raised became diphthongs. Thus, for example, /namə/ developed into /nem/ name[5]; /swe:tə/ > /swit/ sweet; /ri:d/ > /raid/ ride; /spo:n/ > /spun/ spoon; /du:n/ > /daun/ down. This is why the vowel graphemes do not hold the same phonemic value or fit as in most languages using the Roman alphabet. Furthermore, in words like nation ~ national, nature ~ natural, divine ~ divinity, there was a slight alternation in the length of the stressed vowel. During the shift, there occurred a more complex alternation in vowel quality resulting in the use of the same spelling for both alternates.

Another factor affecting English orthography is the foreign influence. Two types of borrowing can be identified. One is the changing of spelling conventions or alphabetic symbols by scribes of a conquering people. The other is simply the borrowing of words containing a foreign spelling and

pronunciation. The former type was most common before the invention of the printing press: the latter was encouraged by print. During the early invasions of England by the Roman armies, the Latin alphabet, which was well fit for the five vowel Latin sound system, was introduced in Britain. As one result, the pre-Latin "runic" symbols, Thorn, , and Eth, , were eventually replaced by th. The Norman invasion of 1066 also brought change. Old English c had two phonetic shapes [č] cild > child and [k] cōc > cook. The Anglo-Normans substituted their digraph ch [č] for the Old English c where it is [č]. Furthermore, the Anglo-Norman scribes began using the French distinction for two different pronunciations of c, corresponding to the modern sound values: /s/ preceding e, i, y (cell, cylinder, city) and /k/ preceding o, u, a, another consonant, or the end of a word (coat, cup, cap, clap, frantic).

Another type of borrowing is the retention of foreign spellings and foreign pronunciation: caprice, routine, sabre, bouquet, ballet, tse tse fly, junta. The same process occurs in the American place names in the once French inhabited Midwest: Champaign, Terra Haute. Likewise, the names Michigan and Chicago, although originally derived from American Indian, have French spellings for /š/, because the names were borrowed into English through the French. Thus, borrowing plays a role in forms of spelling.

A large number of silent letters have arisen from the resurrecting of Classical Latin spellings even though their pronunciations were lost long before the words entered English through French. The Renaissance writers in their zeal for giving classical languages and cultures a "rebirth"

gave English fanciful learned spellings. Classic examples are the following. The silent b in debt, doubt, and subtle, though not even pronounced in the early French words from which the English words were borrowed, e.g., dette, douter, soutil, was reinserted because the earlier Classical Latin forms had a pronounced b, e.g., debitum, dubitare, subtilis. Likewise, the silent g spellings in sovereign and foreign were based on Classical Latin regnum instead of Middle French souverein, forein. Furthermore, the h in rhyme is based on the Latin spelling rhythmus instead of Old French rime, ryme. The case of the silent s in island resulted through popular etymology. Old French île/isle[īl](<Latin insula) became associated with Middle English īland so that the spelling of one influenced the other. The Old English compounds ig-land, ea-land, 'water land' did not have an s.

The most common non-etymological element in the orthography is the inverse spelling, a spelling analogy, in a sense. The words right, light, and fight formed a strong spelling paradigm. When the O.F. deleiter (> M.E. delyt or delite) was borrowed into English, it was given an Anglo-Saxon spelling delight. This may have also occurred by popular etymology where the meaning of delight may be associated with the meaning light, as in a "bright" disposition. Other cases of spelling analogy include schooner after the model school; whole after who and whom; and plague (<plage), league (<lege 'distance'), rouge (<roge) after catalogue, colleague, league 'group', vague. This last set was possibly encouraged to prevent the g from being pronounced as a [ǰ] before e; the u serves as a diacritical marking to indicate a hard g.

Spelling pronunciation, where the printed spelling effects the pronunciation (c.f. often pronounced with the [t]), is an artifact of the print culture, especially when print was primarily read aloud as it was before the introduction of corrective lenses into Western culture (Maher, 1973, p. 9). During the Renaissance a silent h was inserted after t in many words: throne, theatre, thesis, author, even when the digraph indicated a dental stop (c.f. French auteur). This is a result of reborn knowledge of Greek. The h in author was inserted by analogy to the Greek origin words. Then, spelling pronunciation yields the th of author to be pronounced as in native inherited English thunder. The print effected the pronunciation change. It is interesting to note that the /t/ pronunciation and spelling often shows up in alternate forms:

Catherine - Kate
Anthony - Tony (c.f. Antoine, Antony, Antonio)
Elizabeth - Betty
Arthur - Art
Dorothy - Dot[6]

The shortened form retains the older pronunciation. However, an irregularity is created when not all th's are given spelling pronunciations: Thomas - Tom, Theresa - Terry.

All of the above factors have brought about a complicated English orthography which reflects linguistic and cultural history. Carl D. Buck (1933, p. 44) summarizes this best:

> English spelling rests on an early mixture of Old English and French spelling, followed by various orthographical reforms inconsistently applied, with many letters not pronounced in English (as in k in knight, the l in calm), some etymologically correct, but never pronounced in English (as the b in debt), some not even etymologically justified (as the s in island)--all together resulting in the most unphonetic spelling conceivable.

Thus, English orthography is a challenge to the beginning reader and to many spelling reform movements.

Toward spelling reform. For centuries reformers have tried to regularize English orthography for easier writing and reading. Spelling reform history may be divided into two major parts. The early attempts were for establishing a conformity among varying spellings in use; the later attempts were for changing the spellings once the previous conventions became established.

Two factors had strong impact upon the stabilization of various spelling practices: the invention of the printing press (c 1450) and Samuel Johnson's Dictionary of the English Language (1755). Typesetters needed a conventional spelling for words to produce the books of the Renaissance. Printers didn't always have time to think about whether a word is spelled with a k or a c, or with a ch or an sh. With months of typesetting practice, the printer's hand developed habits of going to particular compartments for letters instead of deciding among several variants. But the printer himself wasn't always consistent, especially when deliberately adding or deleting a silent letter to make his lines even (e.g., know, knowe, kenowe).

While printing encouraged a fixed spelling for practical reasons, the rise of dictionaries and normative-prescriptive grammar gave a prescriptive impetus to a fixed spelling in the post-Renaissance epoch. Both written and spoken language were subjected to salvation or damnation. Divided usage was reduced to only one "correct" form. Sentence structure was judged against the rules of Joseph Priestly in 1761, Robert Lowth in 1762, Thomas

Sheridan in 1756, and George Campbell in 1776. Divided usage in spelling was arrested by Samuel Johnson in his 1755 dictionary: "...every language has likewise its improprieties and absurdities, which it is the duty of the lexicographer to correct and proscribe (Preface)."

Johnson used two criteria for deciding the "correct" spelling of a word: its etymology and its usage by the majority of educated writers. Thus, he chose ch in enchant, enchantment which English borrowed directly from French; but the c in incantation which comes from Latin. Similarly, he chose entire over intire as he recognized that the word came from French entier, not directly from Latin integer. When appealing to the usage of educated writers, Johnson chose the various spellings convey-inveigh; deceit-receipt, fancy-phantom. And sometimes Johnson entered a word twice if he couldn't decide a correct form: choak-choke; soap-sope; fewel-fuel.

Other spellings for which Johnson argued were the ck in musick, politick, and critick; and the our in honour and colour. But, according to Webster (1828, Preface), Johnson introduced instructer in place of instructor in opposition to the common usage of -or by Milton, Locke, Addison, and Johnson, himself. Ironically, Johnson didn't change collector, cultivator, objector, and projector.

Because these spelling variations were prescribed as correct, many inconsistencies became frozen into the spelling tradition. There were many attacks upon Johnson's dictionary by other authorities, but the printers used the dictionary as their spelling "Bible". So despite an attempt to conform a spelling system, Johnson didn't always promote a "goodness of fit" between spelling and speech. While the 18th century was the epoch of "conform", the 19th century was the epoch of reform.

Another spelling reform was effected by Noah Webster when the United States was still in its infancy. The impetus for a reform proposal was the fervor of American nationalism after the Colonies broke their political ties with England. Webster preached for an American government, an American culture, an American language, and an American orthography. An American spelling reform would encourage the publication of American books:

> The inhabitants of the present generation would read the English impressions, but posterity, being taught a different spelling, would prefer the American orthography...besides this, a national language is a band of national union. Every engine should be employed to render the people of this country national; to call their attachments home to their own country; and to inspire them with the pride of national character..(Webster, 1789, p. 397).

Although many editions of Webster's American Dictionary of the English Language varied in consistency of reformed spellings, several changes were successful in breaking away from British traditions. The -re in theatre, lustre, centre, was replaced by er yielding theater, luster, center.[8] The spelling -ence was changed to -ense as in defence > defense. Another change was -our being replaced by -or: Saviour, colour, flavour, honour > Savior, color, flavor, honor. Also, there was a simplification of double consonants in some words: traveller, waggon > traveler, wagon.

Although the following were prescribed by Webster in his dictionaries, they were later rejected: the deletion of silent letters in hed, giv, bilt, relm, doctrin, imagin, definit; s > z reezon; ch > sh masheen (machine), shevaleer (chevalier); ch > k karacter; ph > f fantom; o > u abuv; ow > ou croud; ea > ee reeder, meen, zeel, neer; ea > e bredth, fether, thred, wether; eo > e lepard; io > o fashon; ui > u juce; ei > e plebean; ui > i gillotin (Mencken, 1919).

Despite Webster's plea for reforms, he was not totally consistent in the use of revised spellings in each edition of his dictionary. Like Johnson, Webster didn't level the irregularities completely. Lymann Cobb and Joseph Wenchester noticed inconsistencies in the 1828 edition of the American Dictionary: acre > aker, but lucre; deletion of final f in bailiff, mastiff, plaintiff, but not in distaff; deletion of final k in frolick, physick, but not in frolicksome (Mencken, 1919, p. 386). Despite many inconsistencies, Webster made the greatest impact upon spelling reform in America. However, the major problems of irregularity were not solved. The American plea for a simplified spelling continued through the turn of the century. The American Philological Society, the Spelling Reform Association, and the Simplified Spelling Board published legions of documents and pamphlets to persuade the American public to accept reform. About the only simplification of spelling accepted in the present century occurs in many, but not all, newspapers: rite, thru, tho.

The type of spelling reform envisioned by Webster was a regularization of spelling into consistent conventions without adding new symbols to the alphabet. Webster refuted Banjamin Franklin's proposal of adding six new graphemes to the alphabet. However, early in the 19th century a more radical movement of reform was started by Englishman Sir Isaac Pitman who launched his phonetic alphabet in 1837. Six years later he established his Fonetic Jȳrnal, the publication of his Phonetic Institute in Bath, England. Thus, Phonography or Fonotypy was born. Advantages of adding 17 capital and 17 small letters to our alphabet were advertised by their proponents:

1. Phonetic spelling is based upon the spoken sounds of English.
2. It has a scientific foundation on phonetics.
3. It will make reading and spelling easier and more enjoyable.
4. It is easily taught and learned.
5. Spelling may change with the language and therefore show the exact status of the language at a particular time.
6. It will be an aid to teach foreigners how to read and speak English.
7. Phonetic spelling will overcome dialect variation by prescribing the correct pronunciation exactly.
8. It will diminish the number of letters in words and will therefore save paper, space, and money.

Isaac Pitman was succeeded by Alexander John Ellis who in 1848 published a Plea for Phonetic Spelling, 150 pages of detailed arguments for phonetic spelling reform. Pitman's son, Benn Pitman, carried the arguments to America in 1906, while his grandson, Sir James Pitman, designed the Initial Teaching Alphabet (i.t.a.) used in many primary grade classrooms to teach beginning reading.

While the mainstream phonetic movement is epitomized by the addition of alphabetic symbols to the present alphabet, there have been other proposals for a completely new alphabet. N. E. Dawson (1878) and George Bernard Shaw (Tauber, 1963, p. 199) have proposed very novel sets of symbols based on such phonetic distinctions as voiced-voiceless. However, the radical changes were soon rejected.

Three types of spelling reform have been mentioned: (1) those of Webster and others in America who proposed a simplification of spelling patterns without the addition of new symbols; (2) those like Pitman's who invented additional symbols to achieve one-to-one correspondences between sound and grapheme; (3) those consisting of completely new alphabet.

Despite the legion of arguments against traditional orthography and in favor of simplified spelling, there are many strong cultural and linguistic factors which have prevented spelling reform from becoming a reality. In the first place, instituting a new spelling convention even without new symbols would handicap those accustomed to traditional spelling. Altering the spelling and reading behavior would slow down typists, linotypists, and writers. This would affect the time and cost of publishing books and newspapers. If traditional symbols are changed or more symbols are added, our present typewriters and printing machines would become obsolete along with some of the skills of those people who operate them (Craigie, 1954). People must then learn to read both the new and the old orthographies, unless all books ever written were transliterated into the phonetic alphabet.

A phonetic spelling would create more, not less, problems for lexicographers. Alphabetizing must then be redone: filosofy would come before foren (foreign). Translation dictionaries would also be complicated. For example, an English-French dictionary now distinguishes: rain-pluie; reign-regne; rein-frein. But if these were written phonetically, the dictionary would then for some entries need distinguishing phrases: rain (wauter)-pluie; (ov a king)-regne; (for a hors)-frein (Craigie, 1954, p. 55).

Another resistence to spelling reform is that dialect variation and the speller's perception of sounds will create problems for phonetic spelling. Reformers may argue that the writer may spell the word as he "hears" it. In which dialect will the speaker hear and spell the word park?

Boston, Dallas, Chicago? While some dialects each distinguish cot-caught, all-oil, folk-fork with different pronunciations, other dialects may not. Furthermore, different speakers will spell a word as they hear it in different rates of speech: spoz (suppose), benivlent (benevolent). Phonetic spelling would be so versatile that it may create the same confusion of spellings as early America witnessed in the varieties of raccoon: aroughoun, rackoon, rascone, roacoon, arocoun, racoune, raccon, raccoon (Eggleston, 1894, p. 852). Furthermore, another problem with spelling is that there are several levels of representation for a given word: phonetic, phonemic, morphophonemic. The scribes have captured these levels in different spellings at different times.

Still another reason is that a phonetic spelling would destroy many morphological generalizations and semantic relationships among words. Consider the words cats, dogz, and pachez, each requiring a separate morphophoneme for plural. In a similar way, the learner may lose the visual relationship among allomorphs of the past tense morpheme: printed, jumpt, and seemd. Furthermore, a phonetic spelling will not preserve visually the semantic relationship of words with common root morphemes: ɔthər - ɔthorɪty; polər - pəlerɪty; rijɛkt - rəjɛkšən; nešən - nǽšənəl; spirət - ɪnspərašən.

Finally, what is more important than the problem of visual unfamiliarity among related words is that the close relationship between spelling and sound, although important to learning to read, may not be crucial to comprehension of meaning at the level of the mature reader (Gillooly, 1973; Goodman, 1967).

The act of fluent reading involves more emphasis on cognitive-linguistic interactions of the reader with the page (Smith, 1971; Gibson & Levin, 1975; Rumelhart, in press), rather than the phonological interactions that the reader may have with the page. Certainly the learning to read process involves phonological interpretations of print; but once learning to read is accomplished, decoding orthography to speech isn't always necessary.

As for the purposes of spelling reform, the adult reading fluency is probably the most resisting factor to spelling reform. As John Fisher (1974) pointed out, the familiarity of traditional orthography to millions of busy people is enough to block any reform. People don't have the time to learn a new system. For this reason, the U.S. Congress in 1907 cut off federal funds to the Government Printing Office until President Theodore Roosevelt retracted his order that the government documents be printed in the reformed spellings of the Simplified Spelling Board. It is unfortunate for reformers that a simplified phonetic spelling will block reading comprehension and speed for adults (O'Neil, 1972). Too much attention to visual-phonetic information will overload the reader's visual system causing him to fail to get as much information he needs for comprehension (Smith, 1973, p. 7).

In short, spelling reformers have good intentions in regularizing a "goodness of fit" between English orthography and English phonology. Yet many factors have resisted their efforts. A major question which has concerned educators and linguists for centuries is: What is an optimal orthography for learning to read and for fluent reading? Some of the research on this question will now be examined.

Learning to Read, Writing, and Phonology

Some researchers, arguing that English orthography does present decoding difficulties because of inconsistencies, have proposed to create a close fit by using a different alphabet for initial learning. Others have argued that traditional English orthography is basically consistent, if considered at the proper level of abstraction, and suitable for learning to read. These two possibilities will be presented below.

British reformers have proposed additional symbols to attempt a closer fit between the spoken word and the written form. Perhaps the most famous of these reformers, Sir James Pitman, adapted his grandfather's phonetic alphabet into an alphabet for teaching beginning reading. The initial teaching alphabet (i.t.a.) was designed to provide a more regular fit between writing and speech in order to ease the initial task of learning to read. Designed as a transitional alphabet, its main objective is that the child may learn to read traditional orthography. This is claimed to be generally successful by experimental research (Downing, 1965). Because traditional orthography is shown to be a major cause of difficulty in beginning reading, children learning i.t.a. at the early stages are shown to perform significantly better in reading. The performances of two groups of children were compared after reading instruction. The basal reader series of the control group were printed in traditional orthography. The same basal reading series was printed in i.t.a. and was used by the experimental group. Reading tests, printed in the appropriate orthographies, were used to test the performance of the children. Several conclusions have been drawn in long range studies (Downing, 1965):

1. The i.t.a. group outperformed the traditional orthography group in reading performance.

2. Children made more rapid progress in the i.t.a. group.

3. Slower children improved faster in i.t.a. than in traditional orthography.

4. i.t.a. group children will not perform significantly poorer in reading traditional orthography, once transfer has been made.

5. i.t a. group children will eventually out perform the traditional orthography children in reading speed, accuracy, and comprehension of traditional orthography.

However, a major concern is that transfer of reading skills isn't always smooth. "The success of i.t.a. in improving t.o. (traditional orthography) literacy skills comes only after a plateau or even regression in the growth of such skills at the stage of transition from i.t.a. to t.o. (traditional orthography) (Downing, 1967, p. 263).

The general success of i.t.a. over traditional orthography is attributed to the consistencies of i.t.a. contrary to the problems of traditional orthography (Downing, 1973, p. 223). i.t.a. tries to eliminate different written representations of a single sound. Thus, the diphthong in I like my pie, having four representations in traditional orthography, will be represented with only one symbol in i.t.a.: ie. i.t.a. tries to use different symbols for different sounds that are represented as one symbol in traditional orthography. Thus, the ambiguity of o in on, go, do, oven is eliminated by the distinctive spellings on, goe, dω, uven. Furthermore, where a sound may be represented by a cluster of graphemes in traditional orthography, a sound will have only one symbol in i.t.a.: through vs. th r ω. Also, while in traditional orthography two vowel graphemes

representing one sound may be split as in h-o-p-e, the temporal order of spoken phonemes is preserved in i.t.a. These were the linguistic arguments given by researchers supporting i.t.a. The primary merit of the i.t.a. system is that it facilitates learning to decode because of a more predictable "goodness of fit" between print and speech.

If a criterion for a good orthography is that it facilitates learning to read because of a "goodness of fit" between spoken language and spelling, then English orthography may fail to meet this criterion. English orthography has always been viewed to be irregular by spelling reformers. However, arguments to the contrary have been given by Venezky (1967, 1970), Weir and Venezky (1968), N. Chomsky and Halle (1968), and C. Chomsky (1970).

While the regularity of the correspondence between spelling and pronunciation isn't apparent on a surface phonemic level, there is a greater fit between the orthography and the morphophonemic level of words. Venezky's (1967) model, although not intended to be an operational learning model, is represented by the paradigm: graphemic structure to morphophonemic structure to phonemic structure. The structure of morphophonemic variants of related words gives evidence for regularity of many forms which were traditionally claimed by spelling reformers to be irregular. For example, the silent g in sign is retained because the g sound appears in the related form signify (c.f. malign - malignant, resign - resignation). A similar example is the b in bomb and bombardment. Also, the schwa sound with many graphemic representations is justified by the derived forms: author - authority, polar - polarity. A criterion for the regular orthography is the predictability of sound via the word's morphophonemic structure: the palitalization

of /t/ before /i/, giving a [š] sound, is predictable in words like president - presidential; project - projection.

The predictability of sound from related morphemes with alternating surface pronunciations is a major argument for the claim that English orthography corresponds to the underlying lexical structure of words, and is therefore a "near optimal" representation of the native speaker's knowledge of his language (Chomsky & Halle, 1968; C. Chomsky, 1970). Noam Chomsky (1970, p. 13) asserts that there are advantages of an orthography which corresponds to lexical representations by speakers who already know the language. Redundant phonetic information is omitted and rapid recognition of semantically significant units is achieved. The mature reader is led directly to the lexical base which may appear in different alternate phonetic forms. The lexical similarity of alternative phonetic pronunciations are preserved in the orthography. More examples of alternations are taken from Carol Chomsky (1970, p. 97).

[k] ∿ [s]		medicate	- medicine
		critical	- criticize
[g] ∿ [ǰ]		sagacity	- sage
		prodigal	- prodigious
[d] ∿ [ǰ]		grade	- gradual
		mode	- modular
[t] ∿ [ʃ]	[š]	resident	- residential
		expedite	- expeditious
[t] ∿ [tʃ]	[č]	fact	- factual
		quest	- question
		right	- righteous
[z] ∿ [ž]		revise	- revision
[s] ∿ [z]		gymnastics	- gymnasium

The underlying lexical level of representation and the corresponding English spellings are claimed to have "psychological reality" for the native speaker-reader (C. Chomsky, 1970, p. 99) because speakers recognize alternate forms as related and because the forms have common underlying phonological representations.

The main implications of the Chomskian view of orthography for reading is that fluent readers directly process the written symbols in terms of the abstract lexical spellings, rather than unnecessarily decoding specific predictable phonetic details. As for the child learning to read, C. Chomsky (1970, p. 101) states that the beginner assumes that English orthography is "regular" in pronunciation, and that he later makes a transition into interpreting abstract lexical information as he gains experience in reading and in phonological development. Thus, a goal in teaching reading is for the child to eventually learn to get meaning at the abstract lexical level of words through as little decoding as possible.

Although arguments have been made that English orthography is basically regular at the morphophonemic or abstract lexical level, the assumption that English orthography and generative rules have "psychological reality" has been questioned on historical, phonological, and experimental grounds. The evidence presented earlier in the history of English clearly shows that much of English orthography is the result of natural sound change, the arbitrariness of many scribes and printers, the prescriptivism of lexicographers, the Norman Conquest, and the Renaissance. Maher (1969, 1973) has asserted that vestiges of linguistic and cultural past cannot always be part of synchronic

psychological reality. For example, the gh spelling in delight is a result of a spelling change patterned after earlier English words like right, light. fight, when the word was borrowed from French without a gh spelling: O.F. deleiter > M.E. delyt. Phonological evidence is that delight does not alternate like right: delight-delicious vs. right-righteous. Likewise, there are many cases in English where two words have the same spelling as in wind/wind, sow/sow, bow/bow. Compare also the principle parts of the verbs read and lead, the adjective red, and the noun lead:

read, read, read; red
lead, led, led; lead

These are not optimal aspects of English orthography.

The most generally accepted criterion for a phonological process to have psychological reality is that the rule is "productive." Given that a paradigm of alternations is governed by a phonological rule, and a new word is given to a speaker, he would be able to form the alternates if the rule is productive. The psychological reality of the VOWEL SHIFT rule (Chomsky & Halle, 1968) has been questioned by Steinberg (1973) and by Ohala (1974). The orthography preserves the morpheme identity between related words as: divine-divinity, grave-gravity, severe-severity, cave-cavity, extreme-extremity, verbose-verbosity. Chomsky and Halle postulated a vowel shift rule which represents that native speakers have a generalization relating the sound structure of these words. Steinberg cites an experiment by Robert Krohn. Within meaningful paragraph contexts, a root form is introduced for which the readers are to produce a related form: e.g., trout-troutify-troutical, tripe-tripical-tripify, maze-mazic-mazity. The finding was that

in 90% of the responses by 25 subjects, there was absolutely no vowel change from the base word to the derived form. Of the remaining 46 cases, only 3% were in line with the vowel shift rule. This suggests that the vowel shift rule has no psychological reality for native speakers, because it fails to meet the productivity criterion. However, Steinberg's experimental results cannot be said to constitute a compelling refutation of the validity of the vowel shift rule, since the input stimuli were monosyllabic words, and the vowel shift rule is intended to apply mainly to multisyllabic words. The strongest evidence against the psychological reality of the vowel shift rule is found in a similar experiment by Ohala (1974), who used multisyllabic base words. Ohala asked 26 American English students of art and architecture to assist in preparing an extrapolated or extended dictionary of English. The tasks involved adding suffixes to common root words to produce new derived words out of context. The subjects' pronunciations of derived forms were often contrary to what would be predicted by Chomsky and Halle (1968). Subjects were given words based on the paradigm: detain-detention, explain-explanatory. The Chomsky and Halle vowel shift rule would predict that native speakers, when given the words obtain + ion and obtain + atory, would produce [ʌbtʰɛ́nʃən] and [ʌbtʰǽnətɔrij]. The results were that for obtain + ion, 18 subjects produced the derived form with [ɛ], yet eight subjects left the target vowel in the stem unchanged; and that for obtain + atory, only 10 subjects shifted the target vowel to [æ], while most subjects, 16, pronounced the word with [ɛj].

A similar result was obtained for the velar softening rule which captures the relationship between [k] and [s] in pairs like public-publicity; mystic-mysticism. For the stimulus toxic + ism, 15 speakers responded with [k], only four speakers responded with [s], and seven speakers gave other responses. Finally, with public + ism, 19 speakers responded with [k], six speakers responded with [s], while one speaker gave a different pronunciation. Ohala concluded that speakers produce new derived forms based on analogy with other forms in the lexicon, rather than through any abstract underlying form acted upon by phonological rules.

The implications of the research by Steinberg (1973) and Ohala (1974) are that many generalizations made in generative studies of English, although capturing some relationships among some words in the lexicon and orthography, do not necessarily have psychological reality for native speakers; and, that for many extended words, English orthography doesn't always predict how adult readers will decode them.

Although English orthography does preserve meaningful relationships among many word sets, and although generative relationships may be useful in teaching vocabulary development in the upper grades, implications of generative studies for beginning reading appear hard to find.[9] At the beginning stages of reading, children do not view English orthography as a morphophonemic system. Rather, young children expect to find a regular fit between orthography and phonemes of their language. Additional support for the claim that a regular fit enhances learning to decode can be found in studies by Ruddell (1968). In comparing the use of various beginning

reading programs, Ruddell (1968) has demonstrated that when meaning and language structure are emphasized children perform better in learning word recognition and comprehension skills. Furthermore, another conclusion was that first grade reading programs, in which the grapheme-phoneme correspondences have a high degree of consistency, facilitated significantly more efficient performance in word reading, word study skills, and regular and irregular word identification achievement than did the reading programs which had fewer occurrences of consistent phoneme-grapheme correspondences. Thus, children are able to acquire word decoding skills when regular aspects of English "goodness of fit" are emphasized.

Summary

Fluent reading must be viewed as a psycholinguistic process where meaning is conveyed between writer and reader. Adult reading is not a simple decoding process between written symbols and spoken language, for writing system characteristics play a minimal role in fluent reading (Smith, 1971; Gillooly, 1973). However, a child learning to read must learn to associate printed language with spoken language, the only meaningful form of communication known by the child. While it is very important for initial reading instruction to emphasize meaning (Goodman, 1967), the relationship between orthography and phonological structure should not be ignored. This report has demonstrated that the degree of consistency between a writing system and phonological structure affects the ease of learning to read. A higher degree of "goodness of fit" between sound systems and writing systems promotes learning to read. A lower degree of "goodness of fit" or larger degree of abstractness makes initial learning to read more difficult.

The cross-linguistic and the bilingual studies reviewed in this article provide strong support for the "goodness of fit" hypothesis. Orthography and "goodness of fit" may facilitate or impede learning to read another language. Furthermore, the "goodness of fit" may allow learning to read in a second language by bilingual children before transferring initial decoding skills to learning to read in the mother tongue. But, future research on this issue is needed to examine the particular structures of the particular languages and orthographies involved. Such research would enable a quantitative evaluation of the extent to which these factors contribute to transfer of reading skills across languages.

Much of this article has also been devoted to the nature of English spelling, which has for centuries developed to be very complex. Many different elements of phonological structure are represented in English orthography: phonetic, phonemic, morphophonemic. Furthermore, many items of English orthography reflect many influences of linguistic change, cultural history, and spelling reform. It may be that native English children eventually learn to bring to awareness the different levels of their language as they learn to read English. The child eventually learns to sort out what elements of writing are phonemic, phonetic, morphophonemic, or apparent irregularities. However, English orthography cannot be said to be "near optimal" for learning to read without qualifications. Not all aspects of English orthography have psychological reality, especially those forms from the linguistic past. Although English orthography has benefits for later stages of learning to read, namely, preserving visual similarities among many morphemes and allowing for quick meaning recognition, an orthography

with a closer phoneme-grapheme fit will be more optimal for learning to read. Thus, a child learning to decode as part of initial reading for meaning benefits if there is a close "goodness of fit" for his language.

Footnotes

[1]The author is grateful to Dr. J. Ronayne Cowan, of the Division of English as a Second Language and Division of Applied Linguistics for guidance in developing many ideas for this report. Dr. Cowan has also introduced the concept of the "goodness of fit" hypothesis (Cowan, 1975). The author is also grateful to Dr. Hans Hock, Department of Linguistics, and Dr. Glenn Kleiman, Department of Psychology and Center for the Study of Reading, for comments and suggestions on various versions of this report. The author also wishes to thank Dr. Ladislav Zgusta, Department of Linguistics, for comments on the first draft on spelling history.

[2]Other factors that affect the success of learning to read are the type of reading program, the effectiveness of the teacher, and the background of the child.

[3]Some of the evidence given by Rozin and Gleitman to support this claim are for example: Children can be taught to tap out syllabic units in words more easily than to tap out individual phonemes; and kindergarteners can blend two syllables together much more easily than two phonemes.

[4]Most of the examples of historical forms of language are taken from works on historical linguistics and spelling: Anttila (1972), Baugh (1935), Buck (1933), Fries (1963), Lehmann (1962), Mencken (1919), Müller (1880), Pyles (1964), Sturtevant (1917), Venezky (1970). Many discussions on spelling history are also found in Craigie (1952, 1954), Ellis (1848), Krapp (1925), Laird (1953), March (1893), Mencken (1919), and Pitman (1905).

[5]Hereafter, the symbol ">" will be used to mean "developed into" or "became", while the symbol "<" will be used to mean "developed from."

[6]Specific examples are taken from Pyles (1964, p. 65).

[7]However, for many Americans the l in words like calm, balm, palm is not silent due to spelling pronunciation.

[8]The -re spelling in theatre and centre is often retained in titles or texts for a stylish effect.

[9]It should be understood that applications of theoretical linguistics to reading education are not intended for direct teaching in the classroom. For example, it is not implied that children should be taught the formal representations of generative rules or theoretical devices. Rather, children should learn to be aware of the meaningful relationships among words which the teacher may learn from English generative phonology or historical linguistics. Also, the reading teacher may benefit from an understanding of the English stress system for insights on teaching those aspects of English stress which are regular. See Dickerson (1975) for practical applications of generative stress rules in the English as a Second Language classroom.

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Table 1

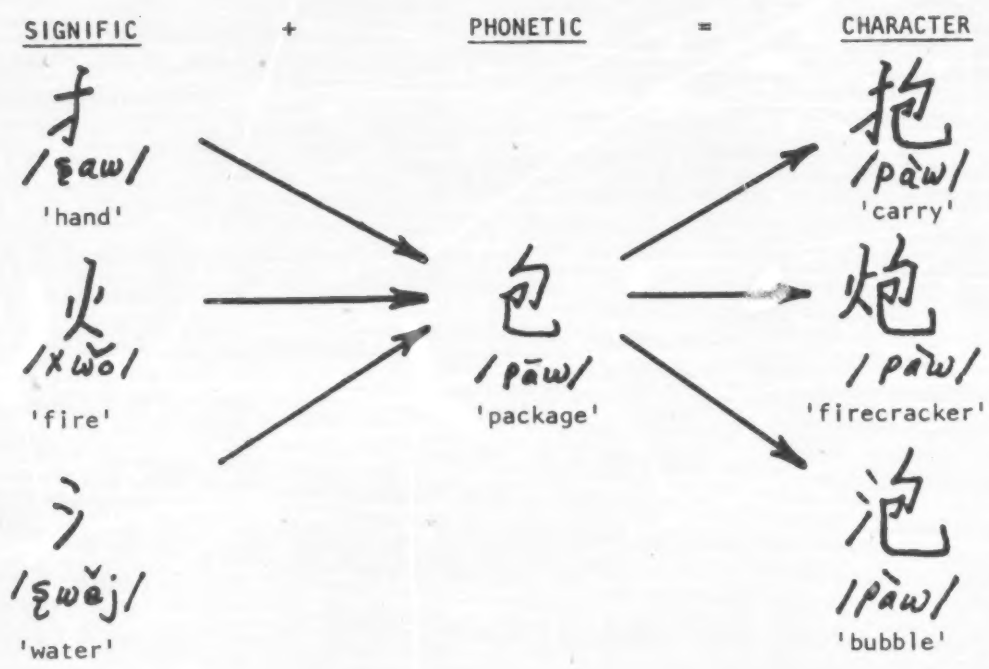
German Spelling

	Morphophonemics		Orthography	
	'advice'	'wheel'	'advice'	'wheel'
Nominative-accusative	/rát/	/rád/	Rat	Rad
Dative (long form)	/rátə/	/rádə/	Rate	Rade
Dative (short form)	/rát/	/rát/	Rat	Rad
Genitive (long form)	/rátəs/	/rádəs/	Rates	Rades
Genitive (short form)	/ráts/	/ráts/	Rats	Rads

Adapted from Moulton (1966, p. 129).

Figure Caption

Figure 1. Example of Chinese writing. (Design by J. R. Cowan)


SIGNIFIC
+
PHONETIC
=
CHARACTER
扌
/ʂaw/
'hand'
火
/xwǒ/
'fire'
氵
/ʂwǎj/
'water'
包
/pāw/
'package'
抱
/pàw/
'carry'
炮
/pàw/
'firecracker'
泡
/pàw/
'bubble'

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